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(54) **DEVICE AND METHOD FOR DRYING FILM**

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(51) **Int. Cl.**

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F26B 3/30	(2006.01)
F26B 9/06	(2006.01)
F26B 25/00	(2006.01)

(52) **U.S. Cl.**

CPC ... ***F26B 3/30*** (2013.01); ***F26B 9/06*** (2013.01); ***F26B 25/003*** (2013.01); *F26B 2200/00* (2013.01)

(58) **Field of Classification Search**

CPC F26B 3/00; F26B 5/00; F26B 19/00; F26B 21/00; F26B 21/06; H01J 9/00; H01J 9/205; G02F 1/00; G02F 1/1335

USPC 34/201, 218, 236, 381; 445/66, 70; 349/106, 110, 187

See application file for complete search history.

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(57) **ABSTRACT**

A film drying device includes a chamber, a film fixing unit in the chamber and configured to fix a film, and a heater in the chamber and configured to apply heat to the film.

24 Claims, 5 Drawing Sheets

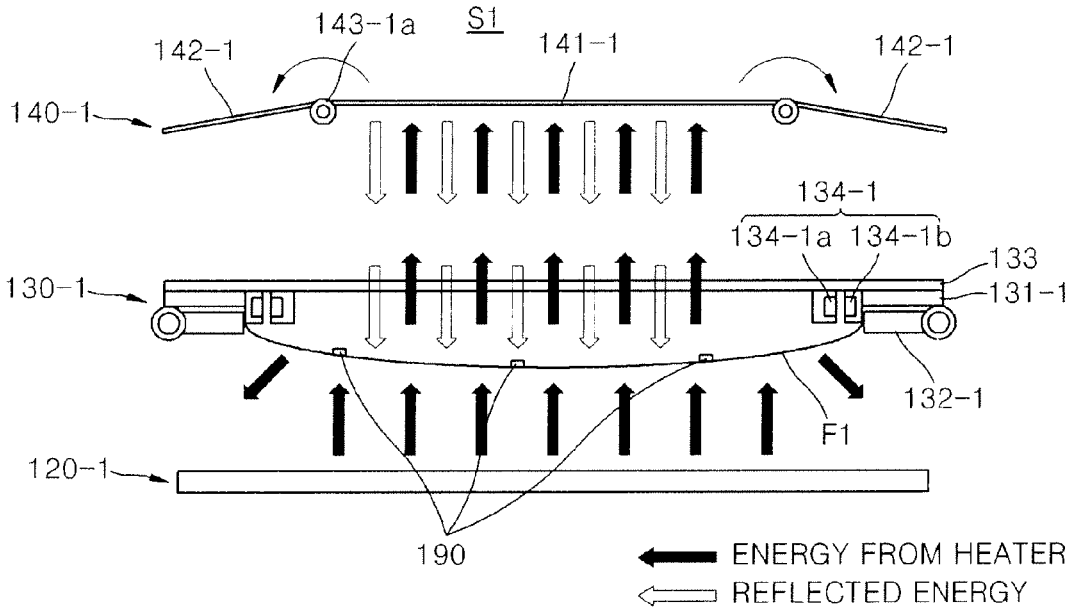


FIG. 1

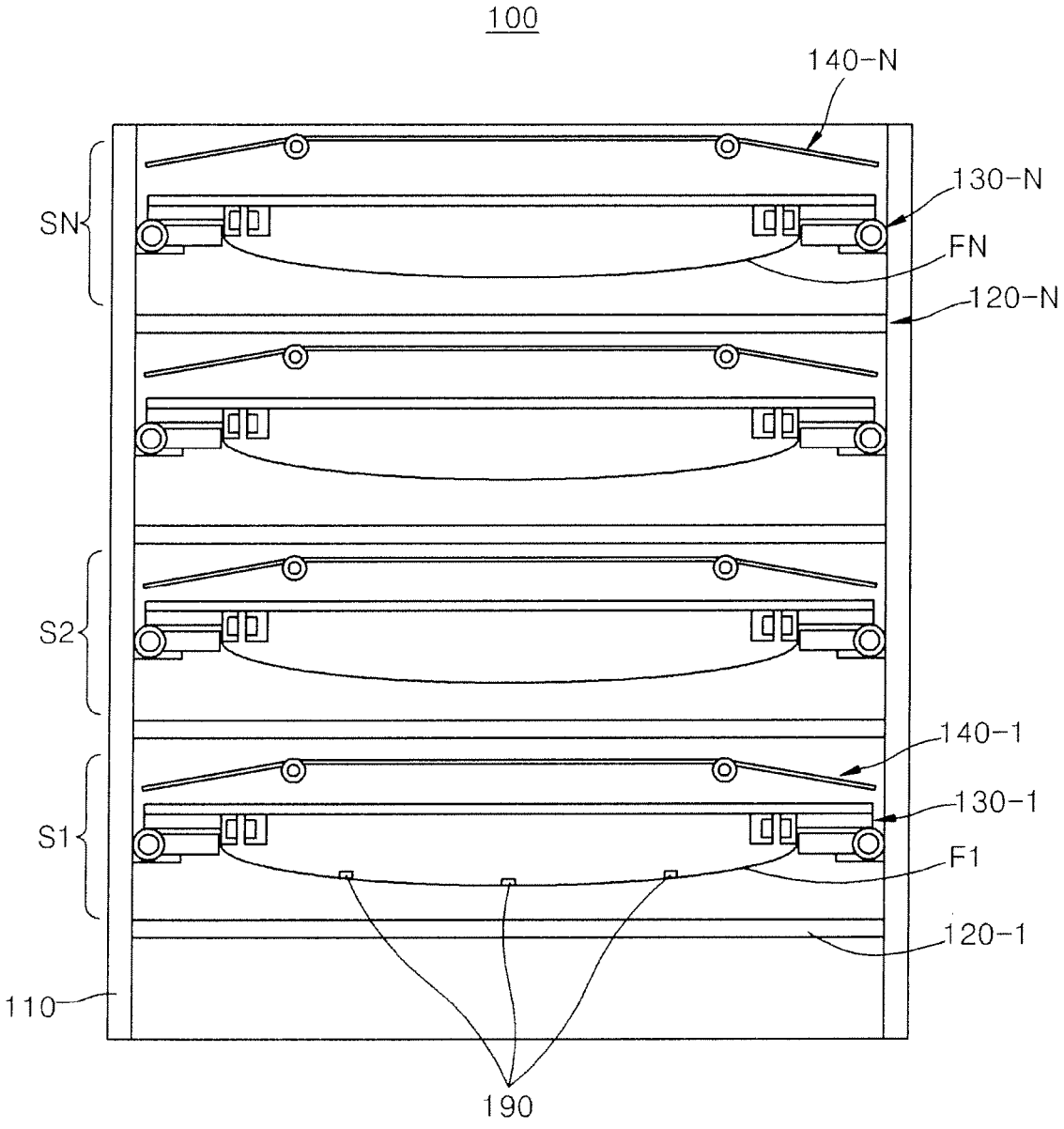
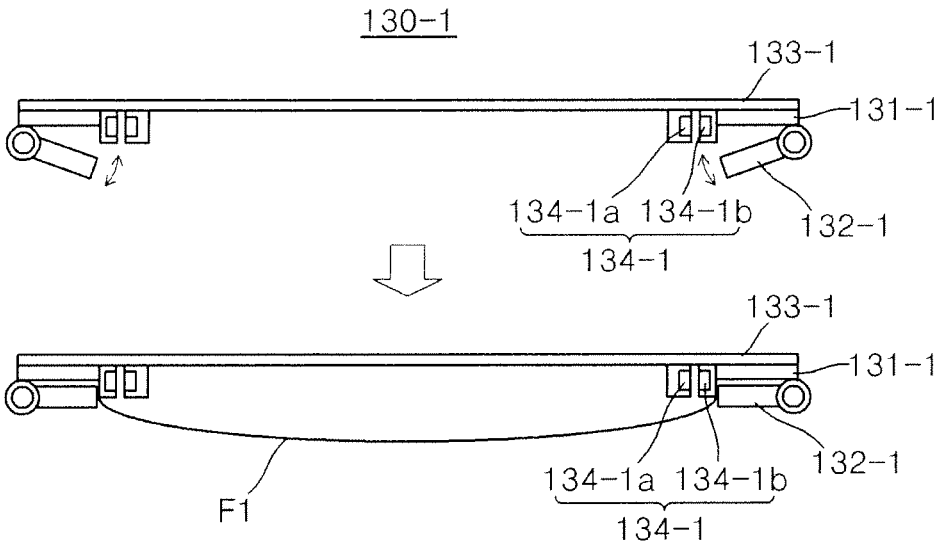


FIG. 2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134-1b
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FIG. 3

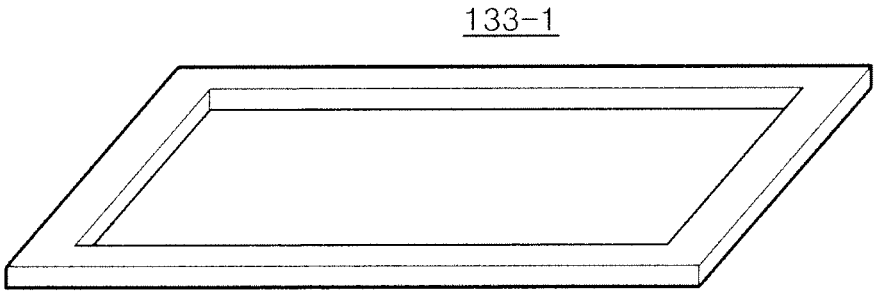

133-1

FIG. 4

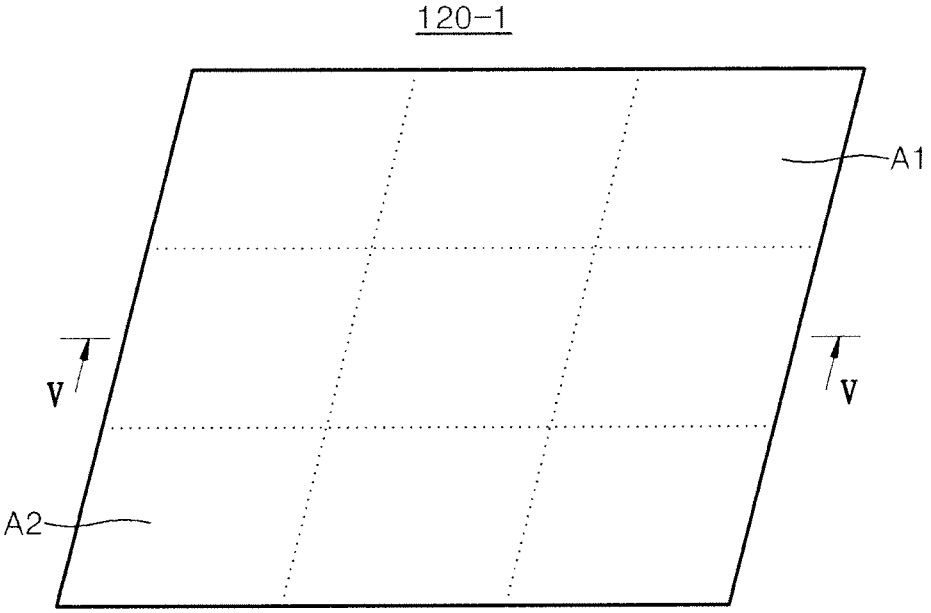


FIG. 5

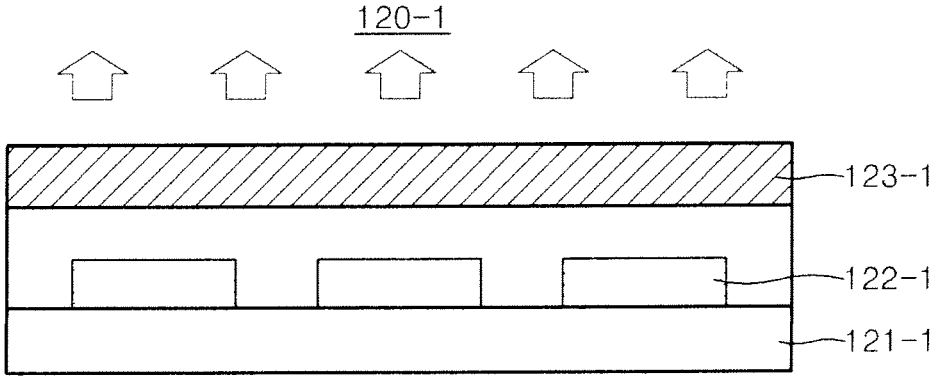


FIG. 6

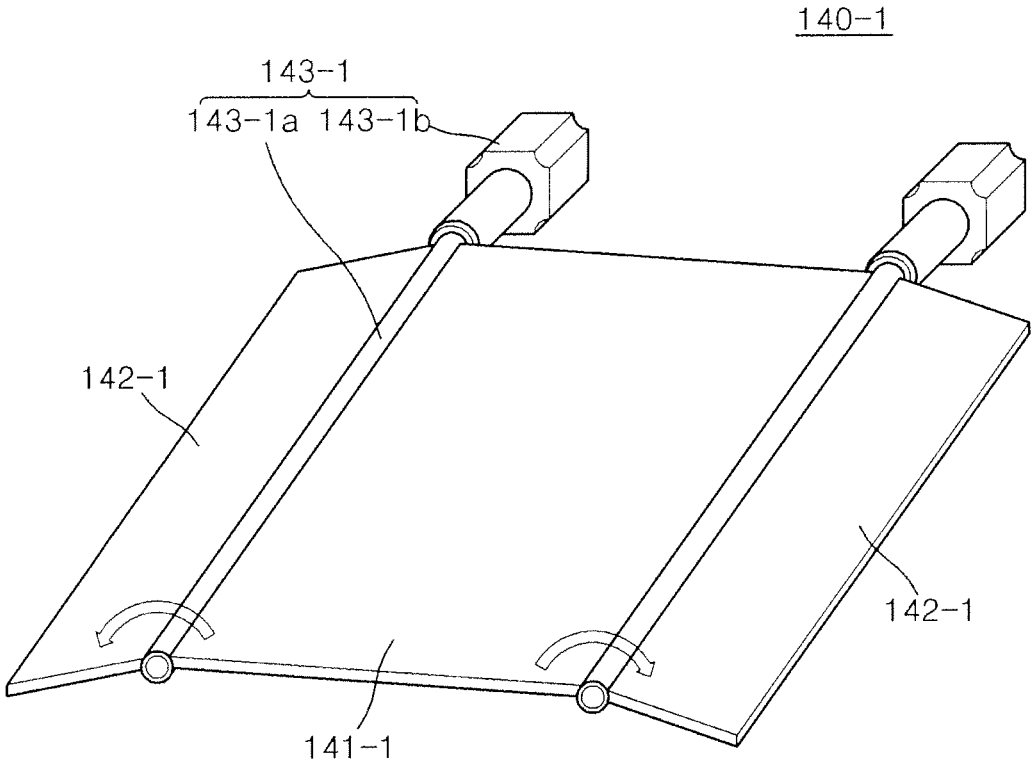
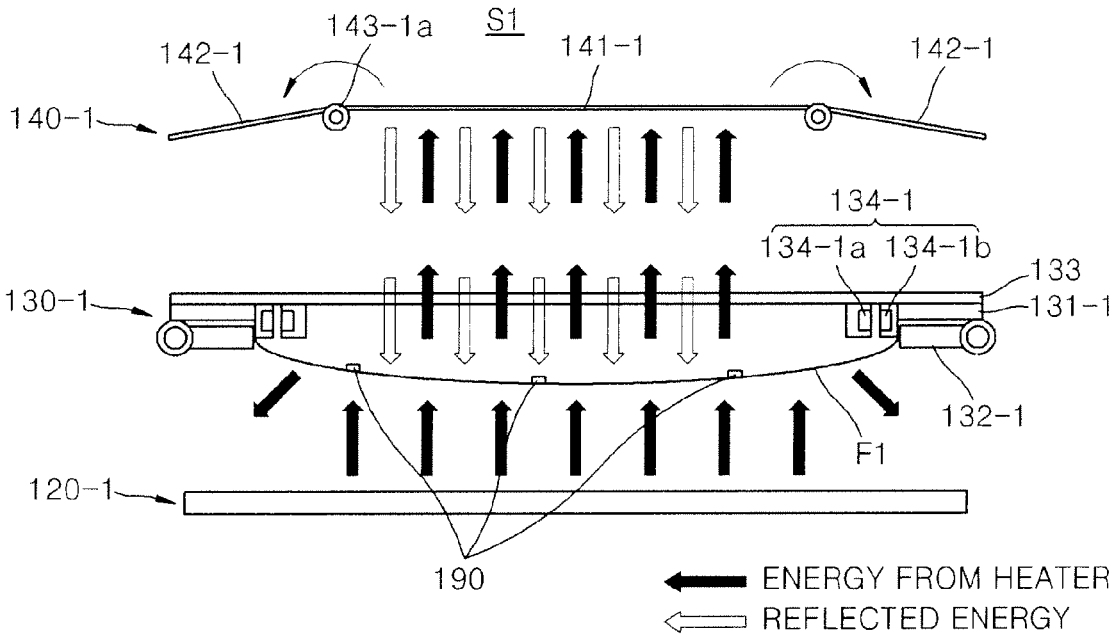


FIG. 7


143-1a
S1
142-1
141-1
142-1
140-1
134-1
134-1a 134-1b
133
130-1
131-1
132-1
F1
120-1
190
ENERGY FROM HEATER
REFLECTED ENERGY

DEVICE AND METHOD FOR DRYING FILM

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2013-0041832, filed on Apr. 16, 2013, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

1. Field

Aspects of embodiments of the present invention relate to a device and method, and more particularly, to a device and method for drying a film.

2. Description of the Related Art

Mobile or portable electronic equipment is widely used. Mobile electronic equipment includes small electronic devices such as mobile phones, and recently, tablet personal computers (PCs), which are widely used. Such mobile electronic equipment includes a display unit to provide a user with visual information such as an image in order to support various functions. Recently, as other parts for driving the display unit become smaller, the importance of the display unit in the electronic equipment is increasing and a structure that may be bent (e.g., that is flexible) to have a given angle (or curve) is also being developed.

Various types of such a display unit may be formed. In this case, a film may be used as a component of the display unit according to a manufacturing process or according to an operating environment after manufacturing. For example, in the process of manufacturing the display unit, it is possible to use various types of film in order to simplify the manufacturing process and to shorten a manufacturing time. In this case, if the film contains an impurity or if an impurity settles on the surface of the film, there may be a decrease in quality of the display unit.

SUMMARY

Embodiments of the present invention provide a device and method for drying a film, which may dry the film quickly and effectively.

According to an aspect of the present invention, a film drying device includes a chamber; a film fixing unit in the chamber and configured to fix a film; and a heater in the chamber and configured to apply heat to the film.

The chamber may be configured to selectively maintain a vacuum state.

The film fixing unit may include a first clamp; and a second clamp connected pivotably to at least one of the chamber and the first clamp, wherein the second clamp may be configured to be selectively coupled to the first clamp to confine the film.

The film fixing unit may further include a body unit mounted movably on the first clamp.

The body unit may have an opening.

The film fixing unit may further include a tension maintaining unit on at least one of the body unit and the first clamp.

The tension maintaining unit may include a first magnetic unit on the body unit; and a second magnetic unit on the first clamp and configured to generate a repulsive force oriented to repel the first magnetic unit.

The heater may be configured to emit a far infrared ray.

The heater may include a first plate; a heating wire in the first plate; and a second plate on the first plate.

The first plate may include aluminum.

The second plate may be configured to generate a far infrared ray.

The second plate may include a ceramic material.

The heater may include a plurality of regions, and temperatures of each of the plurality of regions of the heater may be configured to be controlled independently of one another.

The film drying device may further include a plurality of heaters and a plurality of the film fixing units, and the heaters and the film fixing units may be alternately arranged.

The film drying device may further include a film temperature measuring unit on the film on one of the plurality of film fixing units, the film temperature measuring unit being configured to measure a temperature of the film.

An operation of at least one of the plurality of heaters may be regulated in accordance with the temperature of the film measured by the film temperature measuring unit.

The film drying device may further include a reflective unit configured to reflect the heat emitted from the heater.

The reflective unit may include a first reflective plate; and a second reflective plate pivotably connected to the first reflective plate.

The reflective unit may further include a rotation angle regulating unit coupling the reflective plate to the second reflective plate and configured to control an angle between the second reflective plate and the first reflective plate.

According to another aspect of the present invention, there is provided a film drying method including feeding a plurality of films into a vacuum chamber and then operating each of a plurality of heaters at a temperature; measuring a surface temperature of a film using a film temperature measuring unit coupled to one of the plurality of films; and controlling an operation of at least one of a reflective plate and a heater of the heaters in accordance with the measured surface temperature of the film.

Each heater may have a plate shape and may include a plurality of regions, each of the regions having a temperature, each of the temperatures being independently controllable.

Temperatures of the plurality of regions of each heater may be controlled in accordance with the measured surface temperature.

At least a part of the reflective plate may be pivotable, and a rotation angle of at least a part of the reflective plate may be controlled in accordance with the measured surface temperature.

The film drying method may further include stopping an operation of the heater when the temperature of the film reaches a target temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. **1** is a schematic view of a film drying device according to an embodiment of the present invention;

FIG. **2** is an expanded schematic view of a part corresponding to a slot of the embodiment shown in FIG. **1**;

FIG. **3** is a perspective view of a first body unit of the embodiment shown in FIG. **2**;

FIG. **4** is a perspective view of a first heater of the embodiment shown in FIG. **1**;

FIG. **5** is a cross-sectional view taken along a line V-V of the embodiment shown in FIG. **4**;

FIG. **6** is a perspective view of a first reflective unit of the embodiment shown in FIG. **1**; and

FIG. **7** is a conceptual view of an operating state of a first slot of the film drying device of the embodiment shown in FIG. **1**.

DETAILED DESCRIPTION

Embodiments of the present invention will be described with reference to embodiments to be described along with the accompanying drawings. Embodiments of the present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those of ordinary skill in the art. Furthermore, the present invention is defined by the scope of the claims. The terms used herein are used for describing specific embodiments and are not intended to limit embodiments of the present invention. Terms expressed in a singular form may include plural forms unless clearly otherwise referred to in context. In this application, it should be understood that the term "include," "comprise," "have", "including," "comprising,", or "having" is intended to specify that there are features, figures, steps, operations, components, parts or their combinations represented in the specification and not to exclude that there may be one or more other features, figures, steps, operations, components, parts, or their combinations or that they may be added. In addition, although terms like "a first" and "a second" are used to describe various components, the components should not be limited by the terms. The terms may be used for the purpose of distinguishing one component from another. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

FIG. **1** is a schematic view of a film drying device **100** according to an embodiment of the present invention.

Referring to FIG. **1**, the film drying device **100** includes a chamber **110**. In this case, the chamber **100** includes an internal space and the inside of the chamber **110** may selectively maintain a vacuum state.

The inside of the chamber **110** of the film drying device **100** may be partitioned into a plurality of spaces to form a plurality of slots (S**1** to SN). For example, the plurality of slots may include a first slot S**1** to an N-th slot SN from the lower side of the chamber **110** to an upper side thereof (where N is a natural number). In the embodiment shown, the first slot S**1** corresponds to a reference slot to control the operation of the film drying device **100** and the first second slot S**2** to the N-th slot SN may correspond to spaces in which a film (e.g., a real film or the apparatus to be produced) is dried.

The film drying device **100** may include a film fixing unit that fixes the film in the chamber. In addition, the film drying device **100** may include a heater that is installed in the chamber **110** and that applies energy (e.g., heat) to the film.

The film drying device **100** may include a reflective unit that is installed in the chamber **110** and that reflects energy emitted from the heater. In addition, the film drying device may include a film temperature measuring unit **190** that is installed on the film and that measures the temperature of the film. In this case, the film temperature measuring unit **190** may be installed on one of the plurality of films and may measure the temperature of each region of the film. For example, the film temperature measuring unit **190** may be arranged in the first slot S**1**.

The film fixing unit, the heater, and the reflective unit may be plural in number. For example, a film fixing unit, a heater, and a reflective unit may be installed in each of the first slot S**1** to the N-th slot SN, or may be installed in less than all of the slots.

For example, the plurality of film fixing units may include a first film fixing unit **130-1**, which is arranged in the first slot S**1**, to an N-th film fixing unit **130**-N, which is arranged in the N-th slot SN. In this case, the film fixed to each film fixing unit may include a first film F**1**, which is arranged (or located) in the first slot S**1**, to an N-th film FN, which is arranged (or located) in the N-th slot SN.

The plurality of heaters may include a first heater **120-1**, which is arranged (or located) in the first slot S**1**, to an N-th heater **120**-N, which is arranged (or located) in the N-th slot. In addition, the plurality of reflective units may include a first reflective unit **140-1**, which is arranged (or located) in the first slot S**1**, to an N-th reflective unit **140**-N, which is arranged (or located) in the N-th slot SN.

The film drying device **100** may include a control unit that controls the first heater **120-1** to the N-th heater **120**-N, and the first reflective unit **140-1** to the N-th reflective unit **140**-N. In this case, the control unit may control the first heater **120-1** to the N-th heater **120**-N, and the first reflective unit **140-1** to the N-th reflective unit **140**-N based on the state of the first film F**1** that is measured by the film temperature measuring unit **190**.

The film fixing unit, the heater, and the reflective unit will be sequentially described below in more detail. In addition, for convenience of description, the first film fixing unit **130-1**, the first heater **120-1**, and the first reflective unit **140-1** that are arranged in the first slot S**1** will be described in more detail.

FIG. **2** is an expanded schematic view of a part corresponding to a slot S**1** of FIG. **1**. FIG. **3** is a perspective view of a first body unit **133-1** of FIG. **2**

Referring to FIGS. **2** and **3**, the first film fixing unit **130-1** may include a first clamp (or first clamp portion) **131-1** and a second clamp (or second clamp portion) **132-1** that is pivotably coupled to at least one of the chamber **110** and the first clamp **131-1**. In this case, the first clamp **131-1** may be installed to be fixed to the chamber **110**. In addition, the second clamp **132-1** may be selectively coupled to the first clamp **131-1** to confine (or clamp, secure, hold, or grip) the first film F**1**.

The first film fixing unit **130-1** may include the first body unit **133-1** that is movably placed on the first clamp **131-1**. The first body unit **133-1** may be formed in a plate shape, and may have a hollow part (or window or opening) through which energy (or heat) emitted from the first heater **120-1** may pass.

In addition, the film fixing unit **130-1** may include a first tension maintaining unit **134-1** that is installed on one of the first body unit **133-1** and the first clamp **131-1**. In this case, the first tension maintaining unit **134-1** may include a first magnetic unit **134-1***a*, which is installed on the first body unit **133-1**, and a second magnetic unit **134-1***b*, which is installed on the first clamp **131-1**. For example, the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* may be installed to face each other and may generate a repulsive force.

In this case, the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* may be formed as various types. For example, the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* may include a permanent magnet or an electromagnet. However, for the sake of convenience, an embodiment in which the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* include permanent magnets will be described below in more detail.

FIG. **4** is a perspective view of the first heater **120-1** of FIG. **1**. FIG. **5** is a cross-sectional view taken along a line V-V of FIG. **4**.

Referring to FIGS. **4** and **5**, the first heater **120-1** may be installed at the first slot S**1** of the chamber **110**. In this case, the first heater **120-1** may emit a far infrared ray to the outside.

For example, the first heater **120-1** may include a first plate **121-1** and a first heating wire **122-1**, which is formed in the first plate **121-1**. In addition, the first heater **120-1** may include a second plate **123-1**, which is formed on the first plate **121-1**.

In this case, the first plate **121-1** may include an aluminum material. In addition, the second plate **123-1** may include a material that generates a far infrared ray. For example, the second plate **123-1** may include a ceramic material.

Such a first heater **120-1** may be divided into a plurality of regions. In this case, the temperatures of the plurality of regions of the first heater **120-1** may be regulated (or controlled) to be different from one another. For example, the temperature of a first region A**1** of the first heater **120-1** may be regulated as (or controlled to have) a first temperature, and the temperature of a second region A**2** of the first heater **120-1** may be regulated as (or controlled to have) a second temperature that is different from the first temperature.

The regions of the first heater **120-1** may be set in various ways as needed. For example, the shape, number, and location of the regions of the first heater **120-1** may be formed in various ways according to a user's setting. In this case, the temperature of each region of the first heater **120-1** may be implemented to be different from one another through the first heating wire **122-1** that is distinguishably (or separately) installed on each region (e.g., each region may have its own corresponding first heating wire **122-1** that is separately controlled from other first heating wires **122-1**).

FIG. **6** is a perspective view of the first reflective unit **140-1** of the embodiment shown in FIG. **1**. Referring to FIG. **6**, the first reflective unit **140-1** may be arranged to face the first heater **120-1**. In this case, the first reflective unit **140-1** may reflect energy emitted from the first heater **120-1**.

The first reflective unit **140-1** includes a first reflective plate **141-1** and a second reflective plate **142-1** which is rotatably (or pivotably) connected to the first reflective plate **141-1**. In the embodiment shown in FIG. **6**, the second reflective plate **142-1** is plural in number and may be installed at each end of the first reflective plate **141-1**.

The first reflective unit **140-1** may include a first rotation angle regulating unit **143-1** that connects the first reflective plate **141-1** to the second reflective plate **142-1**. In this case, the first rotation angle regulating unit **143-1** may regulate (or control or limit) a rotation angle of the second reflective plate **142-1**.

For example, the first rotation angle regulating unit **143-1** is configured to rotate and includes a first rotation shaft **143-1***b* that is connected to the second reflective plate **142-1**. In addition, the first rotation angle regulating unit **143-1** includes a first driving unit **143-1***a* that is connected to and that rotates the first rotation shaft **143-1***b*.

The first driving unit **143-1***a* that is formed (or configured) in the above-described way may rotate the first rotation shaft **143-1***b* clockwise or anti-clockwise to regulate (or control) an angle made by the first reflective plate **141-***a* and the second reflective plate **142-1**. In this case, the first reflective plate **141-1** may maintain its original state and only the second reflective plate **142-1** may rotate.

The operation of the film drying device **100** will be described below in more detail.

FIG. **7** is a schematic view of an operating state of the first slot S**1** of the film drying device **100** of FIG. **1**.

Referring to FIGS. **1** and **7**, it is possible to feed the first film F**1** to the N-th film FN into the chamber **110** by opening the chamber **110** before the film drying device **100** starts to operate. In this case, the first film F**1** to the N-th film FN may be fixed to the first fixing unit **130-1** to the N-th film fixing unit **130**-N, respectively. However, because the ways of fixing the first film F**1** to the N-th film FN are the same, only the way of fixing the first film F**1** will be described below in more detail.

For example, in order to fix the first film F**1**, it is possible to rotate the second clamp **132-1** and thus obtain the gap between the first clamp **131-1** and the second clamp **132-1**. In this case, one end of the first film F**1** may be arranged between one first clamp **131-1** and one second clamp **132-1**. In addition, the other end of the first film F**1** may be arranged between the opposite first clamp **131-1** and the opposite second clamp **132-1**.

When the above process is completed, it is possible to rotate the second clamp **132-1** to be in contact with the first clamp **131-1**. In this case, the first clamp **131-1** and the second clamp **132-1** may be fixed by a separate fixing member. Thus, one surface of the first clamp **131-1** may be in completely close contact with the second clamp **132-1** to support (or grip) the first film F**1**.

When the first film F**1** is fixed in this way, the central part of the first film F**1** may sag due to its own weight. In this case, the first tension maintaining unit **134-1** may be used to maintain the tension of the first film F**1**.

For example, when the first film F**1** is installed as described above, the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* may be arranged to face each other. In this case, the first magnetic unit **134-1***a* and the second magnetic unit **134-1***b* may push (e.g., repel) each other due to a repulsive force as described above. For example, a force may be applied to the central part of the first body unit **133-1** due to the repulsive force applied to the first magnetic unit **134-1***a* by the second magnetic unit **134-1***b*, and a force may be applied to the perimeter of the first body unit **133-1** due to the repulsive force applied to the second magnetic unit **134-1***b* by the first magnetic unit **134-1***a*. Thus, because the interval (or space or distance) between the first clamps **131-1** that fix both (e.g., opposite) ends of the first film F**1** grows due to the force having opposite directions, it is possible to maintain the tension of the first film F**1**.

When the first film F**1** is fixed as described above, it is possible to operate the first heater **120-1**. In this case, when the first heater **120-1** operates, it is also possible to simultaneously operate the first heater to the N-th heater **120**-N.

In addition, when the first heater **120-1** to the N-th heater **120**-N operate, the first reflective unit **140-1** to the N-th reflective unit **140**-N may operate. In this case, because the operations of the first reflective unit **140-1** to the N-th reflective unit **140**-N are similar to one another, only the operation of the first reflective unit **140-1** will be described. That is, the first rotation angle regulating unit **143-1** may operate to rotate the second reflective plate **142-1**. For example, the control unit may control the first rotation angle regulating unit **143-1** so that the second reflective plate **142-1** rotates at a rotation angle (e.g., a preset rotation angle).

In this case, the central part of each film may generally become closer to each heater due to self-weight (or its own weight) when each film is fixed to each film fixing unit. Thus, because energy emitted from each heater may be uniform, more radiant heat may be applied from each heater to the central part of each film.

In the above case, energy emitted from each heater may penetrate each film and be transmitted to each reflective unit, and may be reflected from each reflective unit back toward each film. In a case where the first reflective plate **141-1** and the second reflective plate **142-1** of each reflective unit form a plane, all (or substantially all or most of) the energy that is reflected is directed substantially uniformly toward each portion of the film.

For example, in the above case, the sum of the energy emitted from each heater and the energy reflected from each reflective unit may be greatest at the central part of each film and may be smallest at the edge parts of each film. In this case, because energy is not uniformly transmitted to the surface of each film, there may be a limitation (or defect) in that, after drying, the surface of the film is uneven. Thus, by rotating the second reflective plate **142-1** with respect to the first reflective plate **141-1**, it is possible to decrease the gap (e.g., the distance) between the second reflective plate **142-1** and the film and thus increase the energy (or heat) reflected by the second reflective plate **142-1**. Thus, it is possible to uniformly generate energies that reach each film (e.g., supply heat substantially uniformly across each of the films).

When the operations of the first reflective unit **140-1** to the N-th reflective unit **140**-N are completed as described above, the first heater **120-1** to the N-th heater **120**-N operate as described above and it is thus possible to dry the first film F**1** to the N-th film FN. In this case, each of the first heater **120-1** to the N-th heater **120**-N are divided into the plurality of regions as described above, and the control unit may individually control the temperature of each region of the first heater **120-1** to the temperature of each region of the N-th heater **120**-N. For example, the control unit may control each of the first heater **120-1** to the N-th heater **120**-N so that the temperature of each region of the first heater **120-1** to the temperature of each region of the N-th heater **120**-N correspond to temperatures (e.g., preset temperatures).

While the first film F**1** to the N-th film FN are being dried, the control unit may receive feedback regarding the surface temperature of the first film F**1** that is measured from the film temperature measuring unit **190**. In this case, the control unit may determine whether the measured surface temperature of the first film F**1** is the same as a target temperature (e.g., a preset target temperature).

For example, when it is determined that the measured surface temperature of the first film F**1** is not the same as the target temperature, the control unit may control the operation of at least one of the first heater **120-1** to the N-th heater **120**-N and the first reflective unit **140-1** to the N-th reflective unit **140**-N.

For example, when it is determined that the measured surface temperature of the first film F**1** is not the same as the target temperature, the control unit may control the operation of at least one of the first heater **120-1** and the first reflective unit **140-1**. In a case where the control unit controls the operation of the first heater **120-1**, the control unit may control the second heater **120-2** to the N-th heater **120**-N so that their operations are the same as that of the first heater **120-1**.

For example, when it is determined that the surface temperature of the first film F**1** is lower than a target temperature (e.g., a preset target temperature), the control unit may increase energy that is emitted from the first heater **120-1** to the N-th heater **120**-N. On the contrary, when it is determined that the surface temperature of the first film F**1** is higher than the target temperature, the control unit may stop the operations of the first heater **120-1** to the N-th heater **120**-N.

In this embodiment, the target temperature may be set to correspond to each region of the first film F**1**. For example, the control unit may compare the surface temperature of each region of the first film F**1** with the target temperature of each region and then control energy that is emitted from each region of the first heater **120-1** to the N-th heater **120**-N. For example, when the surface temperature of each region of the first film F**1** is lower than the target temperature of each region, the control unit may control the first heater **120-1** to the N-th heater **120**-N to increase energy that is emitted from a corresponding part of the first heater **120-1** to a corresponding part of the N-th heater **120**-N. On the contrary, when the surface temperature of each region of the first film F**1** is higher than the target temperature of each region, the control unit may control the first heater **120-1** to the N-th heater **120**-N to stop the operations of a corresponding part of the first heater **120-1** to a corresponding part of the N-th heater **120**-N. Thus, energy that is emitted from the first heater **120-1** to the N-th heater **120**-N is controlled by region and it is thus possible to uniformly transmit energy to the surface of each film.

In addition, in an embodiment where the control unit controls the operation of the first reflective unit **140-1**, the control unit may control a second reflective unit to the N-th reflective unit **140**-N so that their operations are the same as that of the first reflective unit **140-1**. For example, when the first film F**1** has a region where the surface temperature of the first film F**1** is lower than a target temperature (e.g., a preset target temperature), the control unit may control the operation of the first driving unit **143-1***a* to rotate the second reflective plate **142-1** and thus focus reflected energy on the region of the first film F**1** where the surface temperature of the first film F**1** is lower than the target temperature. In addition, when the first film F**1** has a region where the surface temperature of the first film F**1** is higher than a target temperature (e.g., a preset target temperature), the control unit may control the first driving unit **143-1***a* to rotate the second reflective plate **142-1** in order to prevent reflected energy from becoming focused on (e.g., redirect reflected energy away from) the region of the first film F**1** where the surface temperature of the first film F**1** is higher than the target temperature. In this case, the control unit may also control the second reflective unit to the N-th reflective unit **140**-N so that they operate in the above-described way.

In addition, in an embodiment where the control unit controls the first heater **120-1** and the first reflective unit **140-1**, the control unit may also control the operations of the second heater to the N-th heater **120**-N and the second reflective unit to the N-th reflective unit **140**-N so that their operations are the same as those of the heater **120-1** and the first reflective unit **140-1**. In this case, the ways of controlling the first heater **120-1** to the N-th heater **120**-N by the control unit or the ways of controlling the first reflective unit **140-1** to the N-th reflective unit **140**-N by the control unit are substantially the same as those described above, and their detailed descriptions will thus not be repeated here.

The above processes may be repetitively performed while each film is dried. When a time (e.g., a preset time) passes after the processes are successively repeated through such feedback, the control unit may stop the operations of the first heater **120-1** to the N-th heater **120**-N. In this case, the control unit may change the inner space of the chamber **110** from a vacuum state to an atmospheric-pressure state.

For example, when the inner space of the chamber **110** becomes the atmospheric-pressure state, a user may open the chamber **110** and then remove each film from the chamber **110**. The film is removed in a manner that is the reverse of the sequences described above, and thus a related detailed description will not be provided here.

Thus, according to the film drying device **100** and the film drying method, it is possible to insert and dry a plurality of films in the chamber **110** and thus decrease a necessary working time and increase working efficiency. In addition, the film drying device **100** and the film drying method may receive feedback regarding the state of the first film F**1** installed in the first slot S**1**, regulate drying environments of the second slot S**2** to the N-th slot SN, and thus control drying environments precisely and accurately.

Although the present invention has been described in relation to the above exemplary embodiments, it is possible to make various variations or modifications without departing from the subject matter or scope of the present invention. Thus, the following claims will include such modifications or variations that belong to the subject matter of the present invention and equivalents thereof.

What is claimed is:

1. A film drying device comprising:
- a chamber;
- a film fixing unit in the chamber and configured to hold an edge of a film except a central portion of the film; and
- a heater in the chamber and configured to apply heat to the film.

2. The film drying device of claim **1**, wherein the chamber is configured to selectively maintain a vacuum state.

3. The film drying device of claim **1**, wherein the film fixing unit comprises:
- a first clamp; and
- a second clamp pivotably connected to at least one of the chamber and the first clamp, wherein the second clamp is configured to be selectively coupled to the first clamp to confine the film.

4. The film drying device of claim **3**, wherein the film fixing unit further comprises a body unit mounted movably on the first clamp.

5. The film drying device of claim **4**, wherein the body unit has an opening.

6. The film drying device of claim **4**, wherein the film fixing unit further comprises a tension maintaining unit on at least one of the body unit and the first clamp.

7. The film drying device of claim **6**, wherein the tension maintaining unit comprises:
- a first magnetic unit on the body unit; and
- a second magnetic unit on the first clamp and configured to generate a repulsive force oriented to repel the first magnetic unit.

8. The film drying device of claim **1**, wherein the heater is configured to emit a far infrared ray.

9. The film drying device of claim **1**, wherein the heater comprises:
- a first plate;
- a heating wire in the first plate; and
- a second plate on the first plate.

10. The film drying device of claim **9**, wherein the first plate comprises aluminum.

11. The film drying device of claim **9**, wherein the second plate is configured to emit a far infrared ray.

12. The film drying device of claim **9**, wherein the second plate comprises a ceramic material.

13. The film drying device of claim **1**, wherein the heater comprises a plurality of regions, and
- wherein the temperatures of each of the plurality of regions of the heater are configured to be controlled independently of one another.

14. The film drying device of claim **1**, further comprising a plurality of heaters and a plurality of the film fixing units, and
- wherein the heaters and the film fixing units are alternately arranged.

15. The film drying device of claim **14**, further comprising a film temperature measuring unit on the film on one of the plurality of film fixing units, the film temperature measuring unit being configured to measure a temperature of the film.

16. The film drying device of claim **15**, wherein an operation of at least one of the plurality of heaters is regulated in accordance with the temperature of the film measured by the film temperature measuring unit.

17. The film drying device of claim **1**, further comprising a reflective unit configured to reflect the heat emitted from the heater.

18. The film drying device of claim **17**, wherein the reflective unit comprises:
- a first reflective plate; and
- a second reflective plate pivotably connected to the first reflective plate.

19. The film drying device of claim **18**, wherein the reflective unit further comprises a rotation angle regulating unit coupling the reflective plate to the second reflective plate and configured to control an angle between the second reflective plate and the first reflective plate.

20. A film drying method comprising:
- feeding a plurality of films into a vacuum chamber and then operating each of a plurality of heaters at a temperature;
- measuring a surface temperature of a film using a film temperature measuring unit coupled to one of the plurality of films; and
- controlling an operation of at least one of a reflective plate and a heater of the heaters in accordance with the measured surface temperature of the film.

21. The film drying method of claim **20**, wherein each heater has a plate shape and comprises a plurality of regions, each of the regions having a temperature, each of the temperatures being independently controllable.

22. The film drying method of claim **21**, wherein temperatures of the plurality of regions of each heater are controlled in accordance with the measured surface temperature.

23. The film drying method of claim **22**, wherein at least a part of the reflective plate is pivotable, and
- wherein a rotation angle of at least a part of the reflective plate is controlled in accordance with the measured surface temperature.

24. The film drying method of claim **20**, further comprising stopping an operation of the heater when the temperature of the film reaches a target temperature.

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